

Bridgman-solution crystal growth and characterization of skutterudite compounds CoSb₃ and RhSb₃

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Abstract

Several semiconducting compounds with the skutterudite structure are attractive materials for thermoelectric and electronic applications. Most of them are incongruently melting and their crystal growth from the liquid is not trivial. CoSb₃ and RhSb₃ crystallize peritectically at 873 and 1141 °C, respectively. In this case successful growth has been achieved by using a vertical two-zone furnace with a sharp temperature gradient of 400/cm. Single crystals of these compounds with dimensions of 10 mm in diameter were grown from solutions rich in antimony. A preferential direction of growth corresponded to [111]. Bandgaps of 0.55 eV for CoSb₃ and 0.8 eV for RhSb₃ were estimated from high temperature electrical resistivity measurements. Both compounds can be prepared with p- and n-type electrical conductivities. Exceptionally high p-type Hall mobility values have been measured at room temperature: 3,440 cm².V⁻¹.s⁻¹ at a carrier concentration of 4x10¹⁷ cm⁻³ for CoSb₃ and 8,000 cm².V⁻¹.s⁻¹ at a carrier concentration of 3.5x10¹⁸ cm⁻³ for RhSb₃.